Space and Missile Systems Center

Defense Weather Systems Directorate (SMC/WM)

American Meteorology Society Meetings

Program Status of DoD Weather Satellites

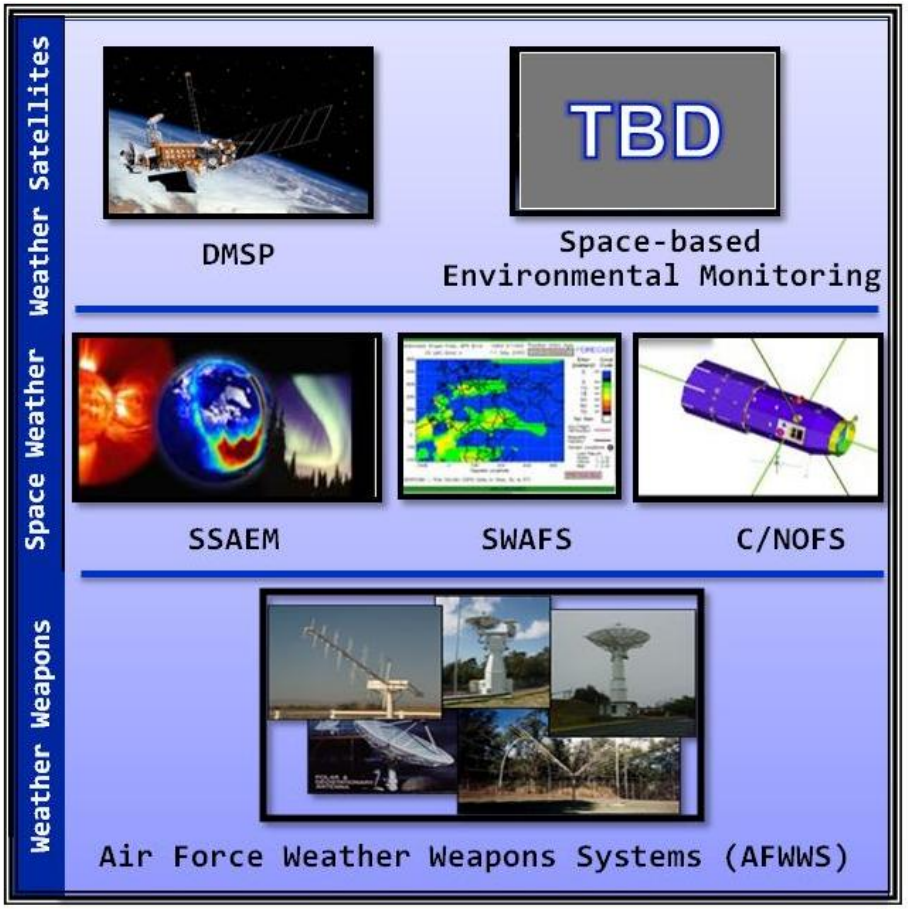
February 2014

John P Baldonado
Deputy Director
Defense Weather Systems Directorate (DWSD)

DWSD Mission Overview

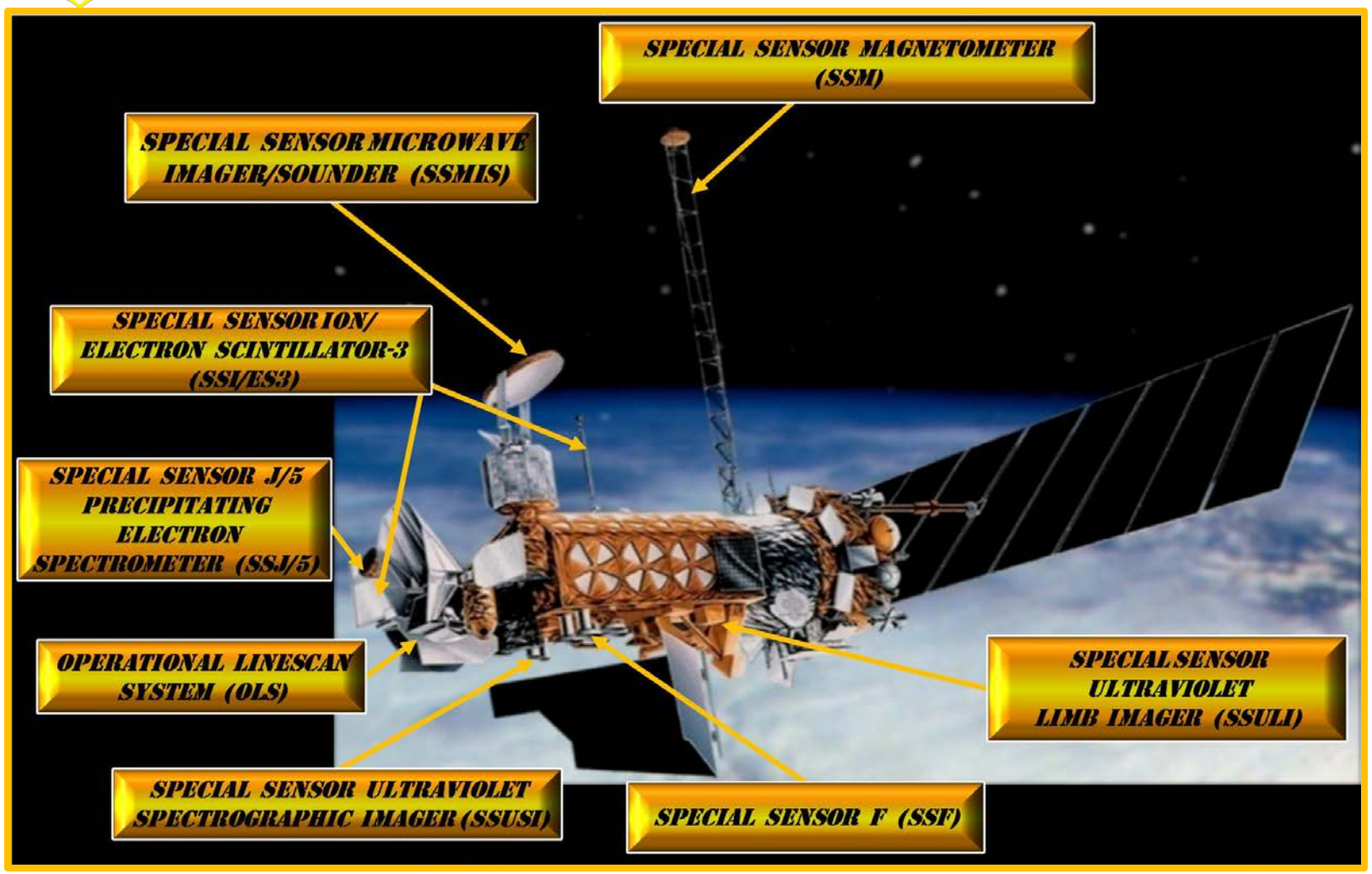
Mission:

Develop, acquire, field and sustain affordable space and terrestrial weather systems to meet Department of Defense requirements



Be the provider of the most effective and affordable space and terrestrial weather systems

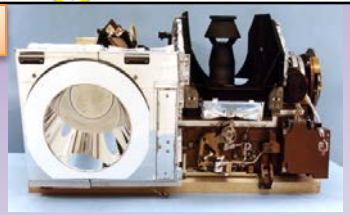
DMSP Spacecraft

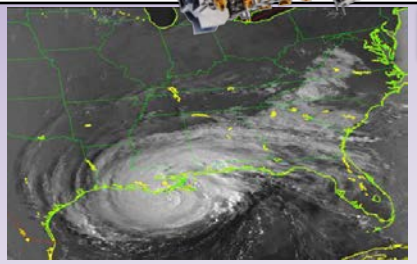


DMSP Sensors
Requirements and Products

SPACE AND MISSILE SYSTEMS CENTER

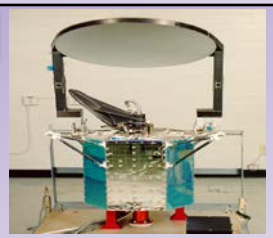
OLS

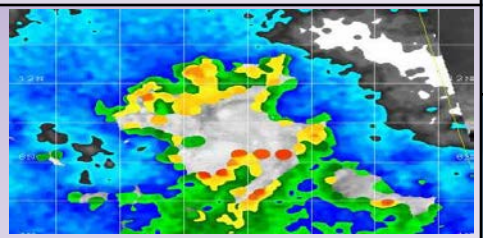




Provides visible and infrared cloud data

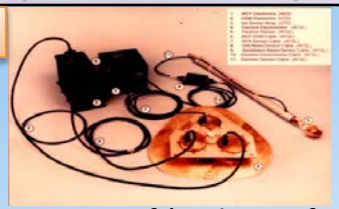
SSMIS

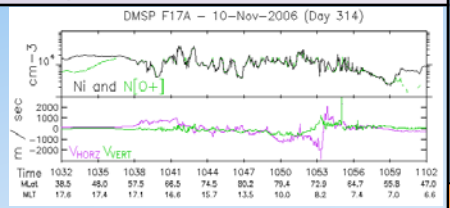




Detects precipitation, surface temperature, and soil moisture

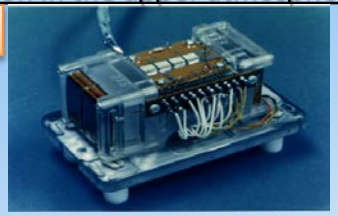
SSI/ES-3

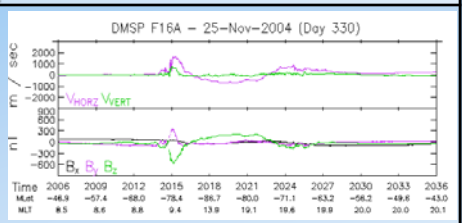




Measures the spacecraft's electric field and electron density and scintillation in the upper atmosphere

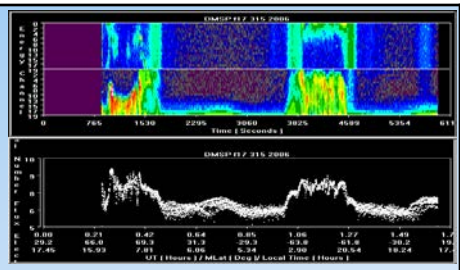
SSM





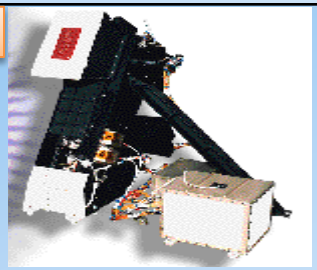
Measures disturbances in the earth's magnetic field

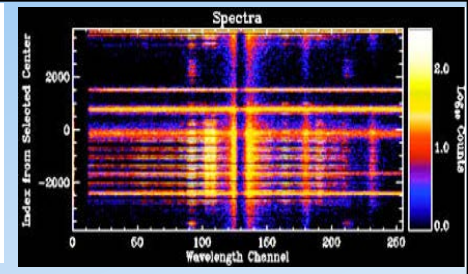
SSJ/5



Analyzes electrons and ions entering the upper atmosphere which produce the auroral display

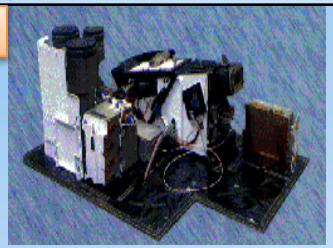
SSULI

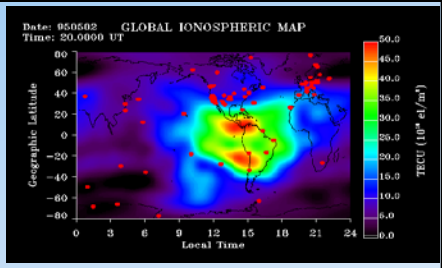




Profiles of natural airglow from atoms, molecules, and ions in the upper atmosphere

SSUSI



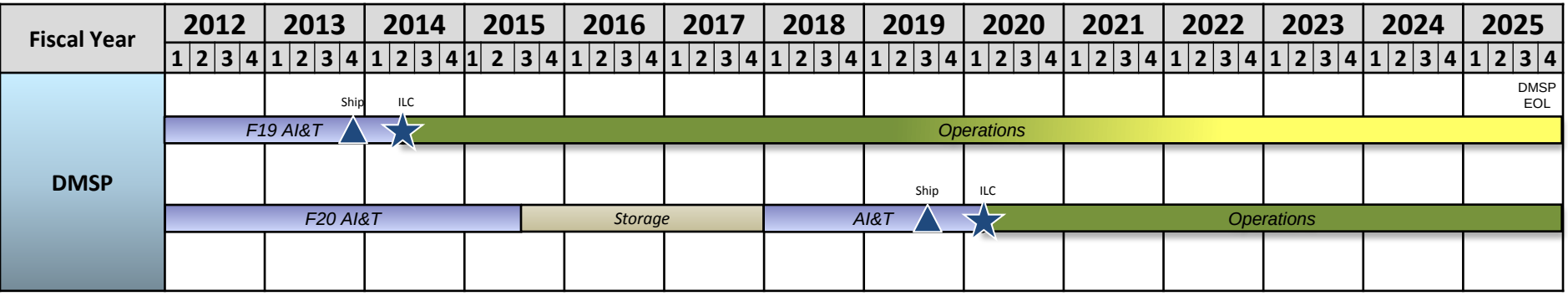


Electron density profiles ,electron/ion density, neutral density, auroral imaging

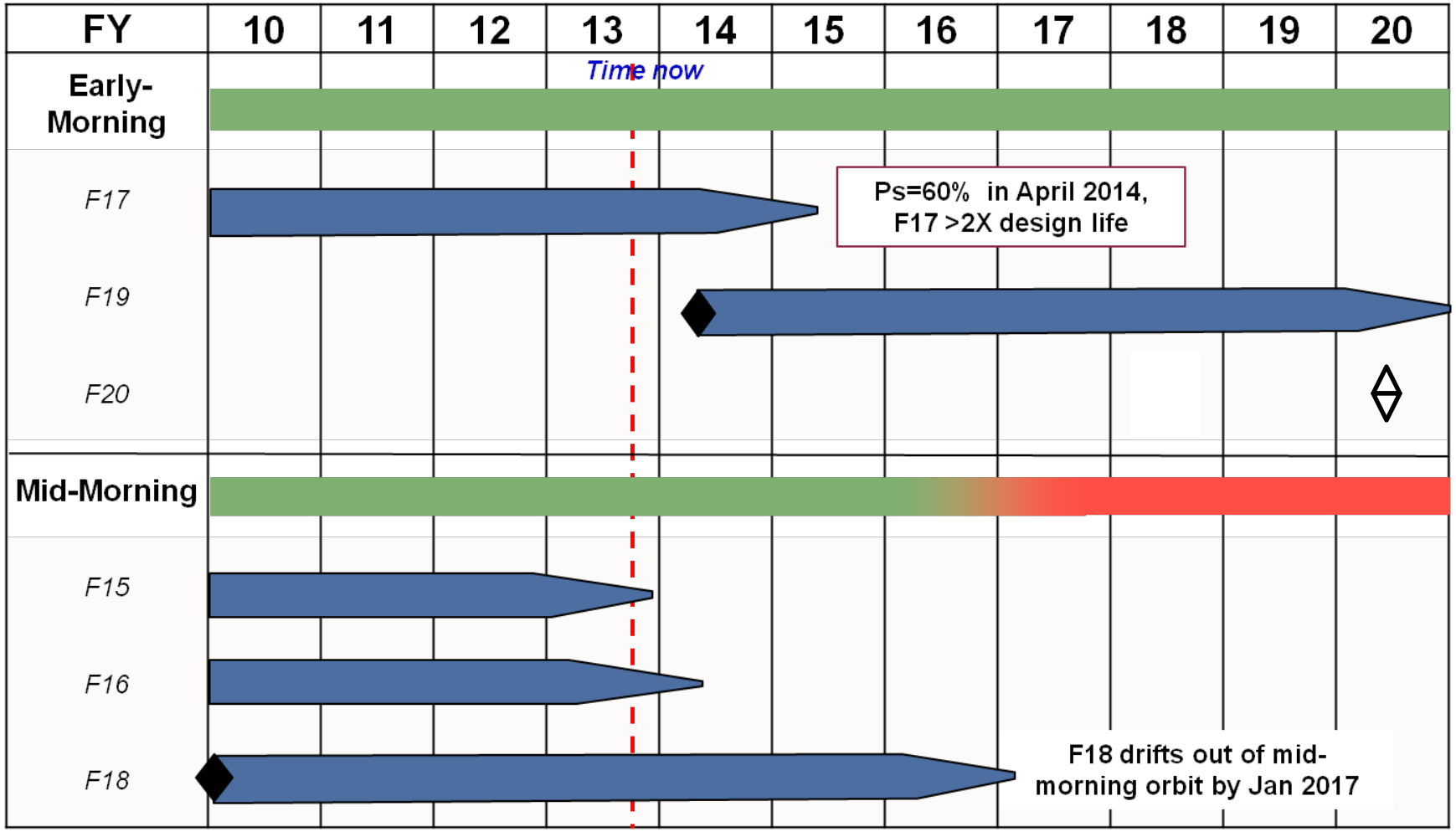
DMSP Sensors Provide All Weather Terrestrial & Space Weather Capabilities

Defense Meteorological Satellite Program (DMSP)

- DMSP continues to meet mission requirements
- DMSP F19 is scheduled to launch into the early morning orbit on 3 April 2014
  - On track to complete integration & launch prep at VAFB
- The two remaining DMSP satellite will be sequentially launch into the single early morning orbit
  - This preserves DMSP capability in the early morning orbit into the next decade
  - DMSP F20 is currently projected to launch in FY2020 pending further directions
- Tech refresh for ground command and control system is planned to extend availability into the next decade



DMSP Constellation Deployment

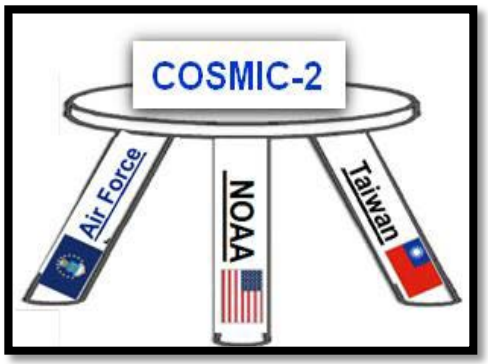


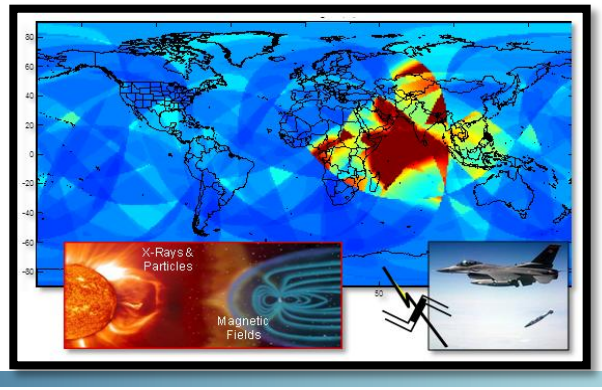
DMSP: Defense Meteorological Satellite Program

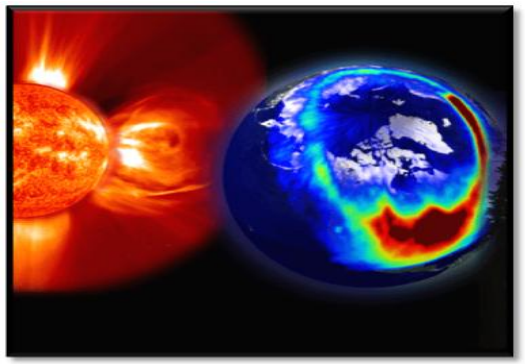
Launch Dates: ◆ ◊ Approved/Approval Pending

Space Weather
Space Situational Awareness and Environmental Monitoring (SSAEM)

- Space Situational Awareness and Environmental Monitoring (SSAEM)
  - Collects ionospheric and Space Weather data to forecast impact on communication, navigation and monitoring systems
  - Part of an interagency & international partnership for affordability and collaboration
    - AF: sensors and launch
    - NOAA: ground system
    - Taiwan: spacecraft (FORMOSAT-7)
    - National Space Policy (28 Jun 10): “Strengthen Interagency Partnerships” and “Strengthen U.S. Space Leadership thru International Cooperation”
- Initial Launch Capability - March 2016







COSMIC-2/SSAEM System Design Overview

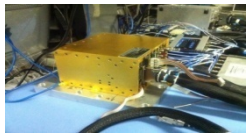
***Concept**: Equatorial part of program is 6 satellite constellation; 3 types of sensors; 3 Cat-A requirements (plus add'l terrestrial wx impact)*

Hosted Payloads *Ground Stations*

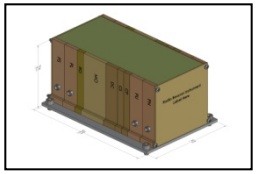
Sensors

- GPS-RO for Electron Density Profile - 6 (1 per S/C)
- RF Beacon for Equatorial Scintillation - 6 (1 per S/C)
- Ionosphere Sensor (IVM) for Electric Field - 6 (1 per S/C)

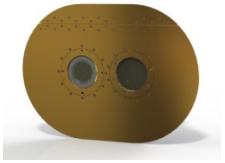
***Sensors**:*



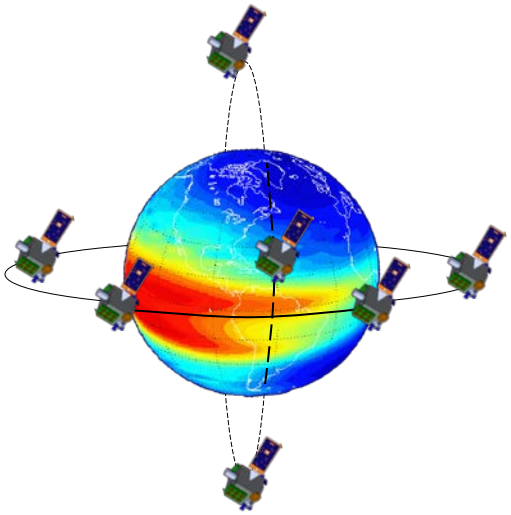
TriG sensor portion of TGRS



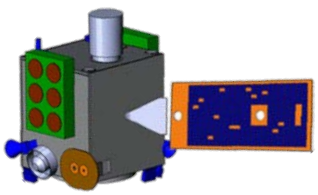
RF Beacon



IVM



***Spacecraft**:*



Depiction of Surrey Space Technologies Limited S/C design

Contribution by Organization	What Provided
Taiwan NSPO	6 Spacecraft (+ option for add'l 6 polar); Satellite C2
NOAA	Interface to Taiwan; TriG NRE; Potential future ground funding
USAF	6 sets SpWx sensors (equatorial); Launch; Beacon ground systems

Weather System Follow-on (WSF)

- WSF is a collection of capabilities to meet DoD validated Space Based Environmental Monitoring (SBEM) requirements
  - Focuses materiel solution to address the Analysis of Alternative's (AoA) highest-priority capability gaps
  - Drives towards disaggregation
- WSF encompasses more than a microwave satellite
  - Space weather missions that leverage previous AF investments and commitments
  - Incorporating Overhead Persistent Infrared (OPIR) data into ground systems
  - Improved tools to bring civil and international weather data to operational weather centrals
- SBEM AoA Status
  - AoA completed 3 Oct 2013
  - AF Requirements Oversight Council validated SBEM AoA results 17 Oct 13
  - CSAF approved forwarding final report to DoD Director, Cost Assessment and Program Evaluation (D, CAPE) on 17 Jan 13
  - CAPE currently conducting Sufficiency Review of SBEM AoA Final Report and will provide recommendation to DoD Joint Requirements Oversight Council (JROC)
  - JROC expected to convene Spring 2014 to validate requirements based on AoA findings

WSF Risk Reduction Status

- Technology risk reduction activity was in response to the SBEM AoA to continue the risk reduction/ technology maturation efforts. These projects are leading to a credible path for low-cost ($5-50M/yr) sensor readiness investments allowing for potential acquisition on-ramp.

BAA Efforts	Description	Gaps Met
EO/IR Investments		
JHU/APL (MSIS)	Lightweight COTS EO/IR	Cloud Char, TWI
ITT (E-AVHRR)	Update AVHRR; previously produced high TRL sensor	Cloud Char, TWI
MW Investments		
JPL (Small Sat)	Research concepts to decrease size of MW sensors/ Deployable Antenna	All MW gaps
JPL (COWVR Study)	Compact MW sensor to address ocean surface vector winds	OSWV, Snow Depth, Sea Ice
COWVR Build	Build a flight ready Sensor	OSWV, Snow Depth, Sea Ice
NRL (WindSat)	Streamline MIS-43 design to meet JROCM Cat A Gaps	OSWV, Snow Depth, Soil Moisture, TCI, Sea Ice
Ball (GMI-P)	Modify legacy GMI sensor design to meet CAT A req	OSWV, Snow Depth, TCI, Sea Ice
Boeing (AMR)	Design baseline for new MW sensor; follow on to SSM/I	OSWV, Snow Depth, TCI, Sea Ice
System & S/C Investments		
ATK	Study net-centric architectures and data delivery through LEO to GEO COMSAT	All gaps
Harris	Study ground architecture alternatives	All gaps
U.S. Space	Study commercial approach to acquiring weather data	All gaps
Orbital	Candidate bus and launch vehicle trade space studies	All gaps
Dosimeter Study	Potential low cost particle counter in lieu of SEM components	LEO Energized Charged Particles
JHU/APL (SSUSI-L)	High-TRL sensor for space weather	Ionospheric Density
Millennium	Flight-proven Class C mission bus	All gaps
SSL	HEO architecture option	Cloud Char, TWI
SAIC	Leverage OPIR data from CHIRP	

OSWV - Ocean Surface Wind Vector
TWI - Theater Weather Imagery
TCI - Tropical Cyclone Intensity

MSIS - Multi-Spectral Imaging System
E-AVHRR - Enhanced Advanced Very High Resolution Radiometer
COWVR - Compact Ocean Wind Vector Radiometer

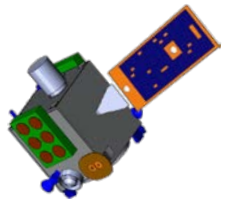
SSUSI-L - Special Sensor Ultraviolet Spectrographic Imager - Lite
GMI-P - Global Precipitation Measurement - Microwave Imager
AMR - Advanced Microwave Radiometer

Summary

- DMSP primary satellites are operational, but with single point failure
  - Several secondary satellites available
  - F19 launch campaign on track
  - Developing storage and reconstitution plan for F20 Launch in FY20 pending further direction
- Implementing SSAEM on COSMIC-2
- Weather Follow-on System risk reduction activities ongoing
  - Leveraging industry ideas to reduce technological risk
  - Awaiting DoD JROC requirements validation
  - Supporting pre-acquisition planning

Back-ups

Space WX Program Schedule



AS OF: 8Jan2013

FY11 | FY12 | FY13 | FY14 | FY15 | FY16

CY10 | CY11 | CY 12 | CY 13 | CY 14 | CY 15 | CY 16

Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1

SSAEM Sensors

CRITICAL PATH

TGRS (TriG Development) : Build, Ship, Integrate, & Test — TGRS SRR; AF CDR; NASA CDR; EN Units; FM#1 Testing; Unit 1; Unit 2-7; IOC

BRE (TriG Production): Build, Ship, Integrate, & Test — Unit 1; TRR; Unit 2-7

RF Beacon : Build, Ship, Integrate, & Test — SRI CDR; EDU TRR; Unit 1 Need Date (w/ Antenna); PDRs; ITT CDR; Space Micro (SRI) Unit 1; Units 2-6

Ionospheric Sensor (IVM) : Build, Ship, Integrate, & Test — EN Units; Unit 1; Units 2-6; RFP Release; DQU Test; FDU Test

NSPO COSMIC-2 Spacecraft

CRITICAL PATH FOR PROGRAM

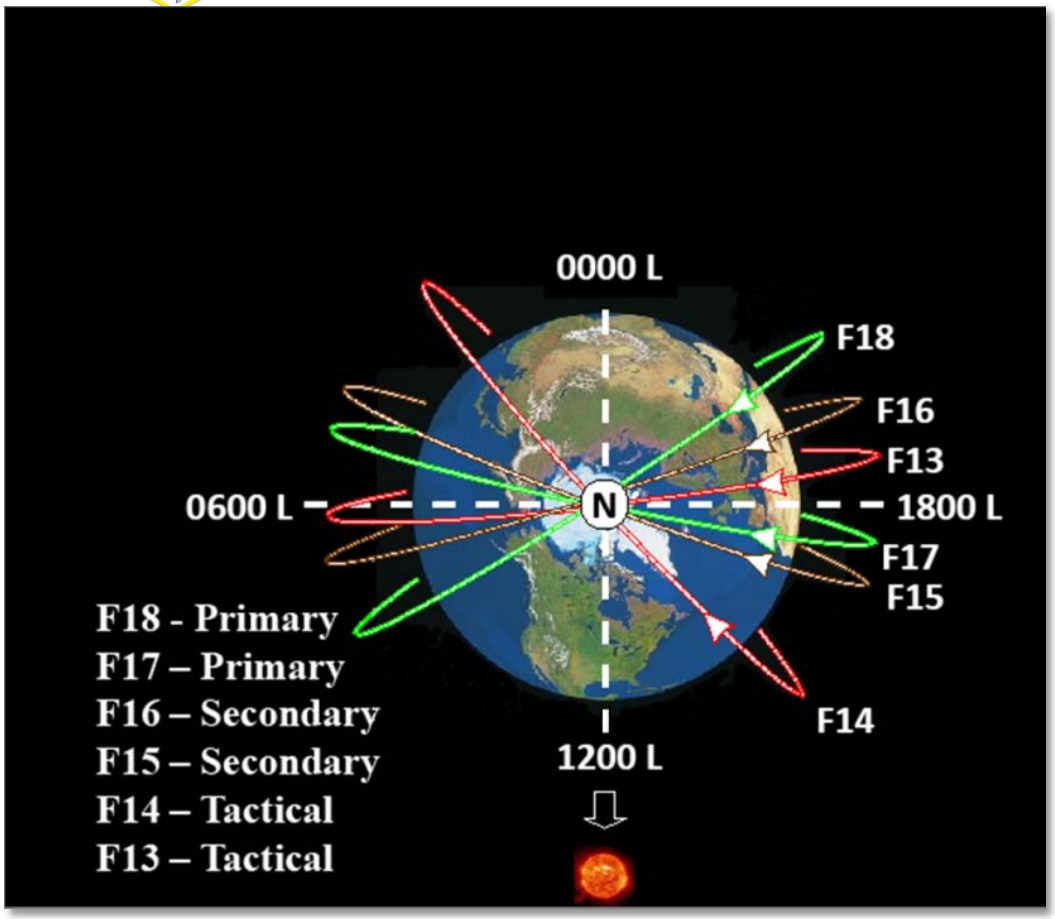
System Definition / Realization of Bus — RFP; 2nd RFP; Contract Award; SDR; PDR; CDR; S/C Integration UK; S/C Integration Taiwan; ITR; FAR; PSR

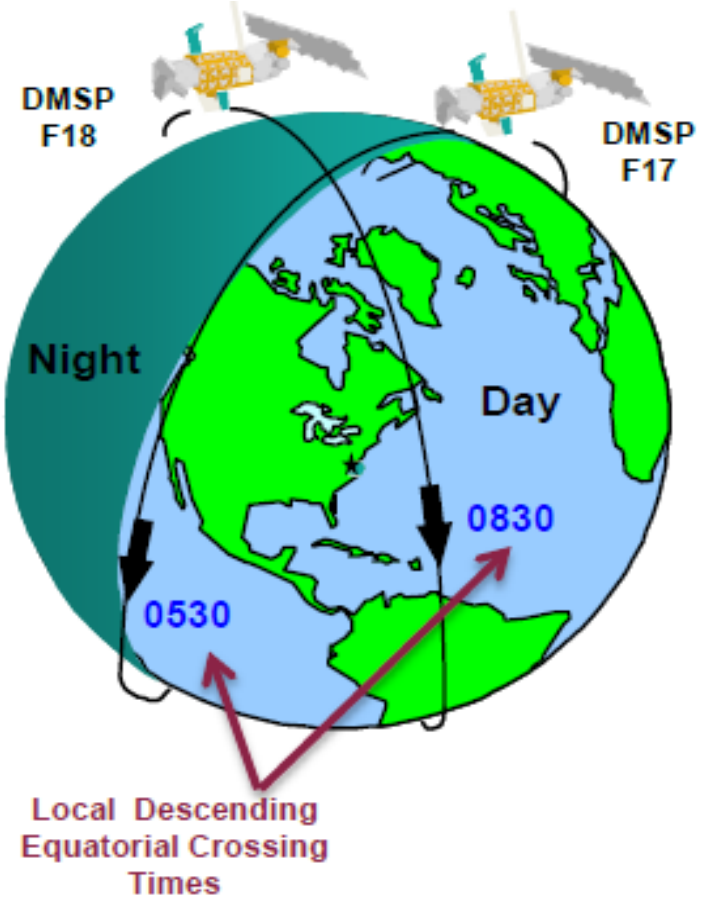
SMC/SD Falcon-9 Heavy Demo LV

STP-2 Award; Launch Vehicle; AF Planned Launch; SSTL Planned Launch; L/V Integration

DMSP Operational Constellation

SPACE AND MISSILE SYSTEMS CENTER





DMSP F19 replaces F17 as primary satellite for early morning orbit